

# WHY DO WE CARE ABOUT STORMWATER DETENTION & CLEANSING?

STORM  
WATER

## Stormwater Detention & Cleansing

David Minnery & George Loew

Stormwater that does not soak into the ground becomes surface runoff, which either flows into surface waterways or is channeled into storm sewers.

Stormwater is of concern for two main issues - one related to the volume and timing of runoff water (flood control and water supplies) and the other related to potential contaminants that the water is carrying (water pollution).

Because impervious surfaces (parking lots, roads, buildings) do not allow rain to infiltrate into the ground, more runoff is generated than in the undeveloped condition. This additional runoff can erode watercourses (streams and rivers) as well as cause flooding when the stormwater collection system is overwhelmed by the additional flow. Because the water is flushed out of the watershed during the storm event, little infiltrates the soil, replenishes groundwater, or supplies stream base flow in dry weather.

Natural drainage has become a standard tool for managing stormwater in Seattle, reducing flooding and improving environmental stewardship. Natural drainage systems strive to meet many goals: slow the flow of stormwater, allow the water to soak into the ground, filter and reduce pollution using the natural processes of soil and plants, reduce impervious (hard) surfaces, increase greenery, and make neighborhoods better places to walk and play.

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[www.cityofnapa.org](http://www.cityofnapa.org)

### MITIGATION STRATEGIES

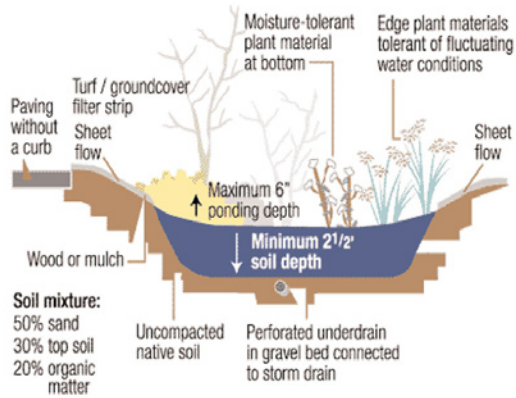
- Wetpond
- Constructed/Pocket Wetland
- Vegetated Swale
- Infiltration Trench
- Sand Filters
- Biofiltration Areas





STRATEGY: WET POND

DESCRIPTION: Constructed stormwater retention basin that has a permanent pool (or micropool). Runoff from each rain event is detained and treated in the pool primarily through settling and biological uptake mechanisms.



KEY CONSIDERATIONS

DESIGN CRITERIA:

- Typically 2 to 6 feet deep
- Maximum contributing drainage area of 10 acres for surface sand filter; 2 acres for perimeter sand filter
- Sand filter media with underdrain system

ADVANTAGES / BENEFITS:

- Applicable to small drainage areas
- Good for highly impervious areas
- Good retrofit capability

DISADVANTAGES / LIMITATIONS:

- High maintenance burden
- Not recommended for areas with high sediment content in stormwater or clay/silt runoff areas
- Relatively costly
- Possible odor problems

MAINTENANCE REQUIREMENTS:

- Inspect for clogging – rake first inch of sand
- Remove sediment from forebay/chamber
- Replace sand filter media as needed

POLLUTANT REMOVAL

80%	Total Suspended Solids
50/30%	Nutrients - Total Phosphorus / Total Nitrogen removal
50%	Metals - Cadmium, Copper, Lead, and Zinc removal
70%	Pathogens - Coliform, Streptococci, E.Coli removal

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[www.georgiastormwater.com](http://www.georgiastormwater.com)  
[www.wetland.org](http://www.wetland.org)  
[www.manchester.gov.uk](http://www.manchester.gov.uk)



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STRATEGY: CONSTRUCTED or POCKET WETLAND

DESCRIPTION: Constructed wetlands are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season) and differ from wet ponds primarily in being shallower and having greater vegetation coverage.



KEY CONSIDERATIONS

DESIGN CRITERIA:

- Minimum contributing drainage area of 25 acres; 5 acres for pocket wetland
- Minimum dry weather flow path of 2:1 (length:width) should be provided from inflow to outflow
- Minimum of 35% of total surface area should have a depth of 6 inches or less; 10 to 20% of surface area should be deep pool (1.5- to 6-foot depth)

ADVANTAGES / BENEFITS:

- Good nutrient removal
- Provides natural wildlife habitat
- Relatively low maintenance costs

DISADVANTAGES / LIMITATIONS:

- Requires large land area
- Needs continuous baseflow for viable wetland
- Sediment regulation is critical to sustain wetlands

MAINTENANCE REQUIREMENTS:

- Replace wetland vegetation to maintain at least 50% surface area coverage
- Remove invasive vegetation
- Monitor sediment accumulation and remove periodically

POLLUTANT REMOVAL

80%	Total Suspended Solids
40/30%	Nutrients - Total Phosphorus / Total Nitrogen removal
50%	Metals - Cadmium, Copper, Lead, and Zinc removal
70%	Pathogens - Coliform, Streptococci, E.Coli removal

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[www.ufz.de](http://www.ufz.de)

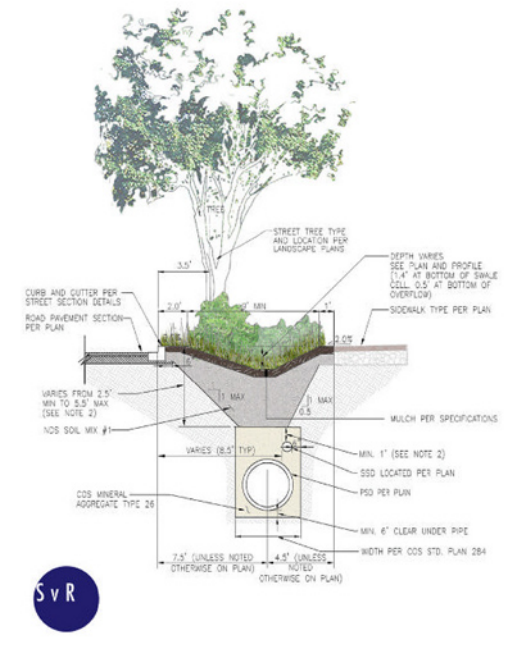
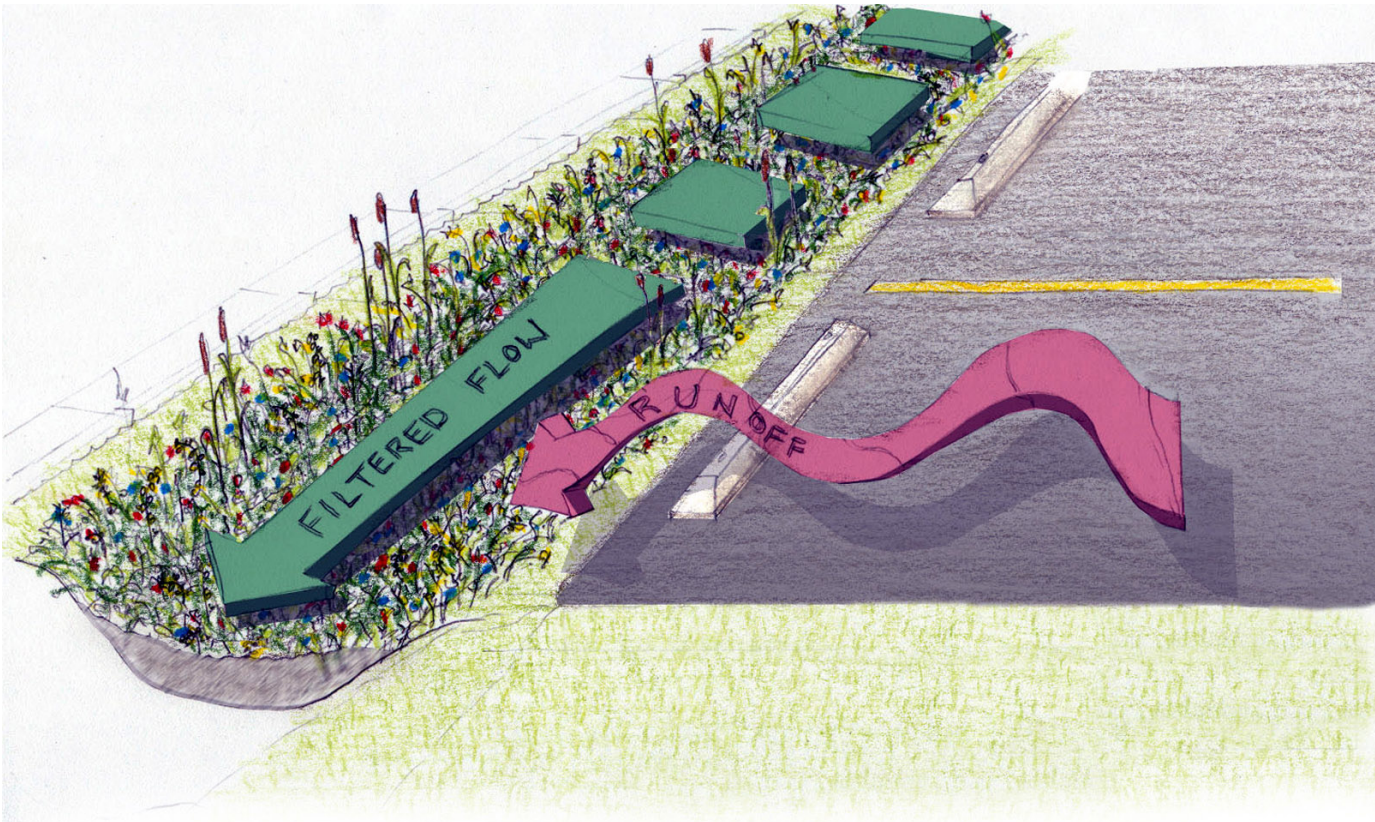


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STRATEGY: VEGETATED SWALE or BIOSWALE

DESCRIPTION: Bioswales are open, shallow channels that collect and slowly convey runoff to downstream discharge points. They are designed and constructed to capture and treat stormwater runoff within dry or wet cells formed by check dams or other means.



KEY CONSIDERATIONS

DESIGN CRITERIA:

- Longitudinal slopes must be less than 4%
- Bottom width of 2 to 8 feet
- Side slopes 2:1 or flatter; 4:1 recommended
- Should be able to adequately convey a 25-year storm event

ADVANTAGES / BENEFITS:

- Combines stormwater treatment with runoff conveyance system
- Less expensive than curb and gutter
- Reduces runoff velocity

DISADVANTAGES / LIMITATIONS:

- Higher maintenance than curb and gutter systems
- Cannot be used on steep slopes
- Possible resuspension of sediment
- Potential for odor / mosquitoes (wet swale)

MAINTENANCE REQUIREMENTS:

- Maintain grass heights of approximately 4 to 6 inches (dry swale)
- Remove sediment from forebay and channel

POLLUTANT REMOVAL

80%	Total Suspended Solids
50/50%	Nutrients - Total Phosphorus / Total Nitrogen removal
40%	Metals - Cadmium, Copper, Lead, and Zinc removal
no data	Pathogens - Coliform, Streptococci, E.Coli removal

STORM WATER

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[www.georgiastormwater.com](http://www.georgiastormwater.com)  
[www.portlandonline.com](http://www.portlandonline.com)  
[www.thehighpoint.com](http://www.thehighpoint.com)  
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POLLUTANT REMOVAL

80%	Total Suspended Solids
50/50%	Nutrients - Total Phosphorus / Total Nitrogen removal
40%	Metals - Cadmium, Copper, Lead, and Zinc removal
no data	Pathogens - Coliform, Streptococci, E.Coli removal



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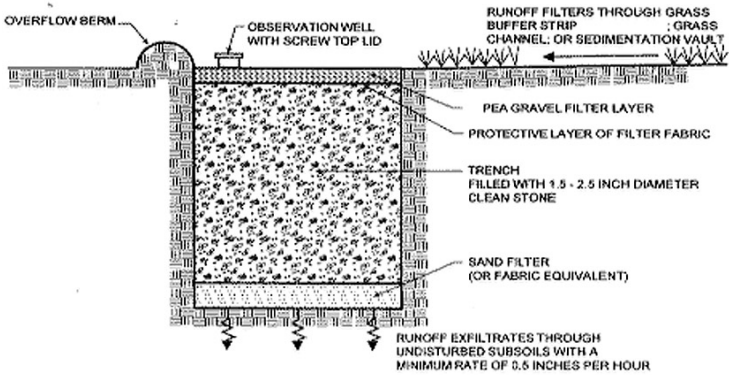
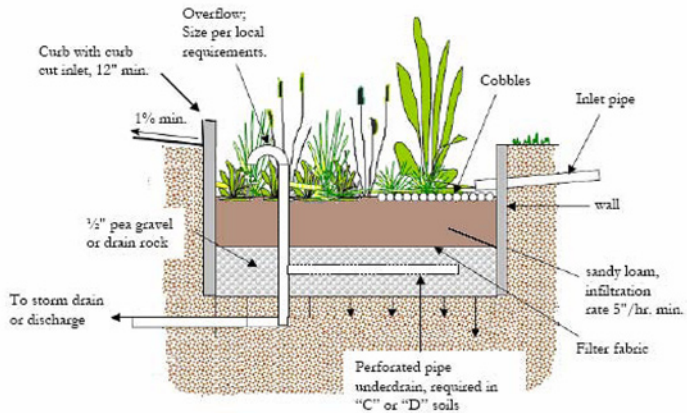


STRATEGY: INFILTRATION TRENCH

DESCRIPTION: Excavated trench filled with stone aggregate used to capture and allow infiltration of stormwater runoff into the surrounding soils from the bottom and sides of the trench.



Infiltration Planter



KEY CONSIDERATIONS

DESIGN CRITERIA:

- Soil infiltration rate of 0.5 in/hr or greater required
- Excavated trench (3 to 8 foot depth) filled with stone media (1.5- to 2.5-inch diameter); pea gravel and sand filter layers
- A sediment forebay and grass channel, or equivalent upstream pretreatment, must be provided
- Observation well to monitor percolation

ADVANTAGES / BENEFITS:

- Provides for groundwater recharge
- Good for small sites with porous soils

DISADVANTAGES / LIMITATIONS:

- Potential for groundwater contamination
- High clogging potential; should not be used on sites with fine-particled soils (clays or silts) in drainage area
- Significant setback requirements
- Restrictions in karst areas
- Geotechnical testing required, two borings per facility

MAINTENANCE REQUIREMENTS:

- Inspect for clogging
- Remove sediment from forebay
- Replace pea gravel layer as needed

POLLUTANT REMOVAL

80%	Total Suspended Solids
60/60%	Nutrients - Total Phosphorus / Total Nitrogen removal
90%	Metals - Cadmium, Copper, Lead, and Zinc removal
90%	Pathogens - Coliform, Streptococci, E.Coli removal

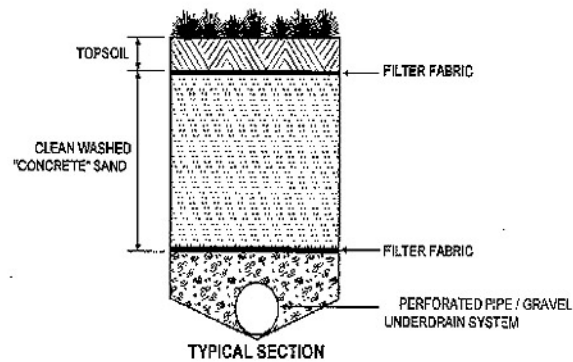
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[www.stormwatercenter.net](http://www.stormwatercenter.net)  
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STRATEGY: SAND FILTERS

DESCRIPTION: Multi-chamber structure designed to treat stormwater runoff through filtration, using a sediment forebay, a sand bed as its primary filter media and, typically, an underdrain collection system.



KEY CONSIDERATIONS

DESIGN CRITERIA:

- Typically 2 to 6 feet deep
- Maximum contributing drainage area of 10 acres for surface sand filter; 2 acres for perimeter sand filter
- Sand filter media with underdrain system

ADVANTAGES / BENEFITS:

- Applicable to small drainage areas
- Good for highly impervious areas
- Good retrofit capability

DISADVANTAGES / LIMITATIONS:

- High maintenance burden
- Not recommended for areas with high sediment content in stormwater or clay/silt runoff areas
- Relatively costly
- Possible odor problems

MAINTENANCE REQUIREMENTS:

- Inspect for clogging – rake first inch of sand
- Remove sediment from forebay/chamber

POLLUTANT REMOVAL

80%	Total Suspended Solids
50/25%	Nutrients - Total Phosphorus / Total Nitrogen removal
50%	Metals - Cadmium, Copper, Lead, and Zinc removal
40%	Pathogens - Coliform, Streptococci, E.Coli removal

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[www.georgiastormwater.com](http://www.georgiastormwater.com)  
[www.limnoterra.com](http://www.limnoterra.com)



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STRATEGY: BIORETENTION AREA

DESCRIPTION: Shallow stormwater basin or landscaped area that utilizes engineered soils and vegetation to capture and treat runoff.



KEY CONSIDERATIONS

DESIGN CRITERIA:

- Maximum contributing drainage area of 5 acres
- Often located in landscaping islands or nature strips
- Treatment area consists of grass filter, sand bed, ponding area, organic/mulch layer, planting soil, and vegetation
- Typically requires 5 feet of head

ADVANTAGES / BENEFITS:

- Applicable to small drainage areas
- Good for highly impervious areas, particularly parking lots
- Good retrofit capability
- Relatively low maintenance requirements
- Can be planned as an aesthetic feature

DISADVANTAGES / LIMITATIONS:

- Requires extensive landscaping
- Not recommended for areas with steep slopes

MAINTENANCE REQUIREMENTS:

- Inspect and repair/replace treatment area components

POLLUTANT REMOVAL

80%	Total Suspended Solids
60/50%	Nutrients - Total Phosphorus / Total Nitrogen removal
unknown	Metals - Cadmium, Copper, Lead, and Zinc removal
no data	Pathogens - Coliform, Streptococci, E.Coli removal

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